|  |
| --- |
| **Lesson Title: Lesson 1 – Kinetic and Potential Energy** |
| **Subject area / course / grade level:Sixth Grade Science** |
| **Introduction**: The potential and kinetic energy of a tennis ball in a tennis match or a basketball in a basketball game show the difference between energy of “Position” or “movement.” Understanding the transfer of energy and the relationship between potential and kinetic energy is the purpose of this lesson. |
| **Lesson Length: 2-50 minute classes** |
| **Materials: Materials:** Playground balls, tennis balls, golf balls, graph paper, Two pieces of notebook paper stapled together as scientist’s notebooks, ball, meter stick. Provide notebook pages for learning disabled students that will help them only fill out data, not copy the other materials. |
| **Lesson Overview:** Students will observe and experiment with the potential and kinetic energy of different balls. Students will write about their observations, hypotheses and conclusions. They will make a data table of their findings and analyze their data by making a graph. Later they will “publish” their findings by comparing their conclusions. |
| **Tennessee Standards:**   * **Science – SPI 0607.10.2** Interpret the relationship between potential and kinetic energy. * **Science - SPI 0607.Inq.3** Interpret and translate data in a table, graph, or diagram. * **Science - SPI 0607.Inq.1** Design a simple experimental procedure with an identified control and appropriate variables. * **Science - SPI 0607.Inq.4** Draw a conclusion that establishes a cause and effect * **Math - SPI 0606.1.1** Make conjectures and predictions based on data. |
| * **Lesson objective(s): Students will** Interpret the relationship between potential and kinetic energy.Students will Interpret and translate data in a table, graph. Students will **1** Design a simple experimental procedure with an identified control and appropriate variables. Students will Draw a conclusion that establishes a cause and effect( shows whether the relationship is direct or inverse between variables). Students will Make conjectures and predictions based on data. |
| **ENGAGEMENT**   * Describe how the teacher will capture students’ interest. * What kind of questions should the students ask themselves after the engagement?   + **Exploration of Pre-Instruction Understanding** * Brainstorm the meaning of energy, potential energy and kinetic energy   + - * Toss a beach ball up and say “kinetic”. Catch it and say potential. Repeat again. Toss the beach ball to a student and say “kinetic.” Prompt the student to say “potential.” Allow students to toss the ball around a few times saying “kinetic” and “potential” at the right times.       * Now have students to enter an “Observation” section in their scientists notebook and underline it.       * Have students write down their observations about watching balls bounce in their scientist’s notebook including examples of potential and kinetic energy       * Ask students what they wrote and write all ideas on the board, accepting all ideas.       * Come to a consensus as a class as to the meaning of potential and kinetic energy and good examples of each.       * Next, ask students to label and underline the next section in their scientist notebooks “Ask a Question”       * Brainstorm with students what questions could be asked in our experiments with balls. Have them think of how potential and kinetic energy related? “How?” Have students write in their scientist’s notebook what questions could they ask regarding how they think potential and kinetic energy are related. Remind them that all questions that scientists ask cannot be adequately tested and this is our goal in this section. Discuss. Now ask them “How can we know they are related?” Test it, of course!       * Now tell students they are going to design a lab to test how potential and kinetic energy of balls are related. |
| **EXPLORATION**   * Describe what hands-on/minds-on activities students will be doing. * List “big idea” conceptual questions the teacher will use to encourage and/or focus students’ exploration   + **Pre-Laboratory Activities**     - Divide students into groups of 3-4 people.     - Use the student template to prepare scientist’s notebook for the lab       * Beginning ideas – from exploration of pre-instruction understanding       * Materials: ball, meter stick       * Safety: eye protection, control balls * ” Have students Label and underline the heading “Hypothesis”   Students design an experiment to answer the following question. “If the ball is held at \_\_\_\_\_\_\_\_cm high, it will bounce to \_\_\_\_\_\_\_\_\_ cm high” Explain that this is an educated guess based upon what they know about bouncing balls..   * + Pick five different heights to test – some higher and some lower - that are at least 10cm apart. Students will have five hypotheses statements (see above), one for each height.   + The starting height of the ball and its bounce are the control (what all other bounces will be compared to).   + The independent variable is the starting height and the height of the bounce is the dependent variable.   + Once the hypotheses are approved, give each group a ball to begin the lab * Ask students to enter a “Testing” section in their scientist notebook and underline it. Explain that most experiments involve collecting data. Our test data will be put in a “data table.” Sixth grade students often confuse “data tables” and “graphs.” In this experiment the data table will be used in the “Testing” part of the experiment and the graph will be used in the “analysis” phase.   + Provide an example of what the data table should look like.      * + **Participation in the Laboratory Activity**     - Students begin the testing phase of the experiment recording their data, Monitor the process of carrying out the experiment and the recording of data.     - Students write their data in their scientist’s notebook data table. * Have students label and underline the next heading “Analysis”   + - Using the data in the data table, students graph their data by making their line graph (Independent variable on x-axis - beginning height of ball- and dependent variable on y-axis – height of bounce).   Students will create a title for the graph and will label the x and y axis.   * Have students label and underline the next heading “Draw Conclusions”   + - After looking at their graphs, students write an explanation of their results that include the statement. “I can claim that the greater the potential energy, the \_\_\_\_\_\_\_\_ the kinetic energy because when the ball is dropped from a higher height,\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The less the potential energy, the \_\_\_\_\_\_\_ the kinetic energy because when the ball is dropped from a lower height,\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.” * Have students label and underline the next heading “Communicate Results”   + - Next, students compare their findings with the other groups by writing their statements on the board , on group white boards, or on butcher paper     - Group discussion of results |
| **EXPLANATION**   * Student explanations should precede introduction of terms or explanations by the teacher. What questions or techniques will the teacher use to help students connect their exploration to the concept under examination? * List higher order thinking questions which teachers will use to solicit *student* explanations and help them to justify their explanations.   + - The teacher will explain the concept of independent and dependent variables by showing that the independent variable is the “One we control in the experiment.” Ask them if we control the starting height or how high the ball will bounce. Students should be able to label the independent variable as the starting height and the height of the bounce as the dependent variable.     - When graphing, the teacher will ask them how they think the data should be organized on the graph. Where should the independent and dependent variables be placed on the graph. Their line graph (Independent variable on x-axis - beginning height of ball- and dependent variable on y-axis – height of bounce). |
| **ELABORATION**   * Describe how students will develop a more sophisticated understanding of the concept. * What vocabulary will be introduced and how will it connect to students’ observations? * How is this knowledge applied in our daily lives? * When students share their group graphs it will become apparent if they have drawn the data correctly and if they have correctly titled the graph or labeled the x and y axis. * Students will be able to understand the vocabulary: potential and kinetic energy; X-axis, Y-axis, independent variable and dependent variable. |
| **EVALUATION**   * How will students demonstrate that they have achieved the lesson objective? * This should be embedded throughout the lesson as well as at the end of the lesson   + - Students will write a reflection of what they learned from sharing group results as part of the “Communicate Results” phase of the experiment.Reading students’ Reflection and Writing portion of the lab can indicate student understanding.     - The scientist journals can be used as an assessment tool.     - Other assessments may include a quiz over potential and kinetic energy that includes how students know what they know or have students make a prediction based on their data how high their ball would need to be held in order to bounce as high as a basketball goal |